batics, have the efficiency $(T_1 - T_0)/T_1$, where T_1 and T_0 are the temperatures of the terminals of the compression line.

Adopting the methods of the writer, the following data are obtained.*

ordinates to pressure, volume and temperature planes. The two cycles are seen in usual form on the p-v plane and their respective diagrams are indicated throughout the figure by full lines for the Carnot, dotted lines for Brayton. The numerals 1 and 1_0, 2 and 2_0, 3 and 3_0, respectively, indicate the same distinction. The common initial point of the diagrams is seen at 0.

R. H. THURSTON.

CHARACTERISTICS OF TYPE-CYCLES.

	Absolute Pressure Lbs. per sq. in.				Absolute Temperature.			
	p_0	p_1	p_2	p_3	T_0	T_1	T_2	T_3
Carnot	15	115	23.8	3.11	520	931	931	520
Otto	15	115	188.3	24.5	520	931	1522.7	852
Brayton	15	115	115	15	520	931	1352.7	755
Ericsson	15	72.3	72.3	15	520	520	931	931
Stirling	15	72.3	133	27	520	520	931	931

	Volumes.				Maximum Pressure.	Maximum Temperature.	Maximum Volume.
	V_0	V_1	V_2	V_3			
Carnot	1	.2334	1.125	4.82	115	931	4.83
Otto	1	.2334	.233	1	188.3	1522.7	1.00
Brayton	1	.2334	.338	1.45	115	1352.7	1.45
Ericsson	1	.207	.372	1.79	73	931	1.00
Stirling	1	.207	.207	1	130	931	1.80

The characteristics of the several cycles are displayed graphically in the usual manner on pressure-volume, on temperature-volume, and on temperature-entropy planes, all of which bring out very clearly the distinctions indicated by the tabulated data; the principal being the great volume of the working cylinder for the Carnot cycle, the comparatively large pressures of the Otto—the Beau de Rochas—and the low pressures of the Ericsson diagram. The Carnot cycle is thought impracticable on account of engine volume, weight and cost; the Beau de Rochas involves very high temperatures and pressures and the Ericsson and Stirling engines seem likely to waste largely by dissipation of heat.

"The Brayton, on the whole, seems to promise best and, while practical obstacles modify any application, it yet remains true that recent reports would seem to place engines operating in this cycle in the lead."

The most novel and perhaps immediately interesting feature of the paper is its illustrations of the cycles discussed by forms in relief. The accompanying engraving is an illustration of one of these—a comparison of the Carnot and the Brayton cycles, referring co-

*Manual of the Steam-Engine,' Vol. I., p. 418.

EXHIBIT OF THE U. S. NATIONAL MUSEUM AT ST. LOUIS.

THE most striking feature of the exhibit of the U. S. National Museum at St. Louis will be the reproduction of a full grown sulphur-bottom whale. The mold for this was obtained through the courtesy of the Cabot Steam Whaling Co. at their station at Balena, Newfoundland, and was made from one of the largest whales taken this summer; a skeleton of the same species was presented by the Colonial Manufacturing Co., of St. Johns, Newfoundland. As definite measures and weights of whales are not easily obtainable some details on these points may be of interest. The animal, a male, from which the skeleton was procured, measured 74 ft., 8 in. from the notch of the flukes to the tip of the nose, or 79 ft. from tip of flukes to tip of lower jaw. The girth around shoulders was 35 ft. and the width of the flukes 16 ft., 5 in. The skull, over all, measured 19 ft. and the width across

the orbits was 9 ft., 3 in.; the length of the jaws was 20 ft. along the outer curve, while the combined weight of cranium and jaws was four tons.

The approximate weight of a specimen of this size, as determined by Mr. S. C. Ruck, are as follows:

	Pounds.
Weight of bones	17,920
Weight of blubber	17,920
Weight of flesh	89,600
Weight of whalebone, including the attached gum	1,750
Weight of viscera and blood, estimated	13,440
Total	140,630

or not far from 63 tons. F. A. L.

MEMORIAL TO SIR WILLIAM FLOWER.*

My Lord Archbishop, Ladies and Gentlemen:

The late Sir William Flower, formerly director of this museum, was one of my oldest and most intimate friends. It was, therefore, with great pleasure that I agreed to the request of the Flower Memorial Committee to say a few words on the occasion of the presentation to the trustees of the bust of the late director.

The bust which, as you will presently see, so well represents the kindly countenance of our deceased friend, is the work of Mr. Thomas Brock, R.A., and no one, I think, will deny that the talented artist has achieved a remarkable success in producing it. But before formally presenting it I may venture to say a few words about him whose memory we seek to honor on the present occasion, and about the excellent scientific work which he performed.

Born in 1831, Flower was a member of a well-known family of Stratford-on-Avon, and, showing remarkable taste for natural history in his early youth, was educated for the medical profession. He graduated at the University of London in 1851 and became a member of the Royal College of Surgeons the same year. In 1852 he read a paper to the Zoological Society on the structure of a species of *Lemur*, the first of a long series of communications to that society which continued for forty-five years.

In 1854, on the Crimean War breaking out, Flower joined the Army Medical Staff, and was present at the battles of Alma, Balaclava and Inkerman, and at the capture of Sevastopool, and afterwards did good work in the British Hospital at Scutari, in acknowledgment of which he received the Crimean medals.

On returning to England, Flower quickly reverted to natural history, and in 1855 was appointed demonstrator of anatomy to the Middlesex Hospital and curator of its museum. Here he did excellent work, and so plainly showed the stuff that he was made of, that six years later, in 1861, on the death of Queckett, he was appointed conservator of the museum of the Royal College of Surgeons. This important post Flower held for twenty-two years and, as we all know, carried out its duties in a most effectual manner. When the president of the Royal Society delivered to Flower the Royal medal in 1882, he said: 'It is very largely due to Professor Flower's incessant and well-directed labors that the museum of the Royal College of Surgeons contains the most complete, the best ordered and the most accessible collection of materials for the study of vertebrate structure in existence.'

From 1870 to 1884 Flower was Hunterian professor of comparative anatomy and physiology, and gave the admirable courses of lectures on these subjects which have rendered his name famous in the annals of zoological science.

In 1879, on the death of Lord Tweeddale, Flower was unanimously elected president of the Zoological Society of London, upon the council of which he had served for many years previously, and retained this post until his death in 1899. In 1884 the directorship of the great Natural History Museum in which we are now assembled became vacant by the death of Professor Owen, and Flower, being *omnium consensu* most admirably fitted for it, was selected for the post. Of the way in which he performed the heavy duties of this

* Full text of Dr. Sclater's address on the occasion of the presentation of a bust of the late Sir William Flower to the trustees of the British Museum, July 25, 1902.